# THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

Volcanoes have always captured the imagination of mankind. Apart from the violent damage which sometimes results from their eruptions, they provide the geologist with a clue concerning the interior of the earth which he can never reach directly. He sees hot liquids and solid particles, called magma, pour out upon the earth's surface where they congeal to form rock, known as igneous rock. He is confronted with the problem of the source of the magma that has made the igneous rock.

In the article "Rock Furnaces" on page 7, C. W. Wolfe describes some of the activities hundreds of miles below the surface of the earth which produce the intense heat within volcanoes, causing eruption and subsequent formation of a rock shell on the surface of the earth.

° °

An interesting feature of the 35th annual convention of the National Crushed Stone Association in Chicago, February 17 through 20, was the award of THE EXPLOSIVES ENGINEER plaque to Columbia No. 1 Quarry, Columbia Quarry Company, Krause, Illinois, for the best safety record among member quarries of the N.C.S.A. for the year 1950. Fifteen other member quarries were awarded engrossed certificates for accident-free records. A description of the ceremony is presented in the article "For Quarry Safety" on page 12.

° °

The diversified activities of six prominent contracting firms at work on a $23,000,000 project, under the direction of the U. S. Army Engineers, are related in the article "A Unique Harbor Development in San Diego's Mission Bay," by Robert Lee Behme. Some of the details involved in the construction of three jetties and a floodway channel section, dredging in the bay, building bridges, and the conversion of 1,800 acres of waste land to useful purposes are described. Please turn to page 13.

° °

The erection of a war memorial building in downtown Rochester, New York, necessitated the relocation of a raceway channel and the construction of a hydroelectric plant. The program called for the drilling and blasting of 17,900 cu. yds. of rock formations, including more than 60,000 ft. of line drilling. Unusual care was required in carrying out these operations to avoid damaging nearby buildings and other permanent structures. In the article on page 19, Carl P. Dintruff presents highlights of the project.

° °

Besides taking care of a normal quota of business at its Chimney Rock property in Bridgewater Township, North Jersey Quarry Company had to expand operations in a hurry to deliver 900,000 tons of crushed stone within a limited period to the Brewster Company's 53-mile stretch of new highway on the New Jersey Turnpike. New equipment was added, the number of employes was increased, and a section of the crushing plant was put on a work schedule of 24 hours a day. In the article beginning on page 22, Albert S. Keshen presents a summary of the major activities at Chimney Rock Quarry.

° °

"Driftwood," on page 24, is a story in verse about a restless, carefree miner who moves from job to job as his fancy dictates. It is a contribution from F. A. Dalburg, Montoursville, Pennsylvania. The author is unknown.

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Trim Your MAINTENANCE EXPENSES

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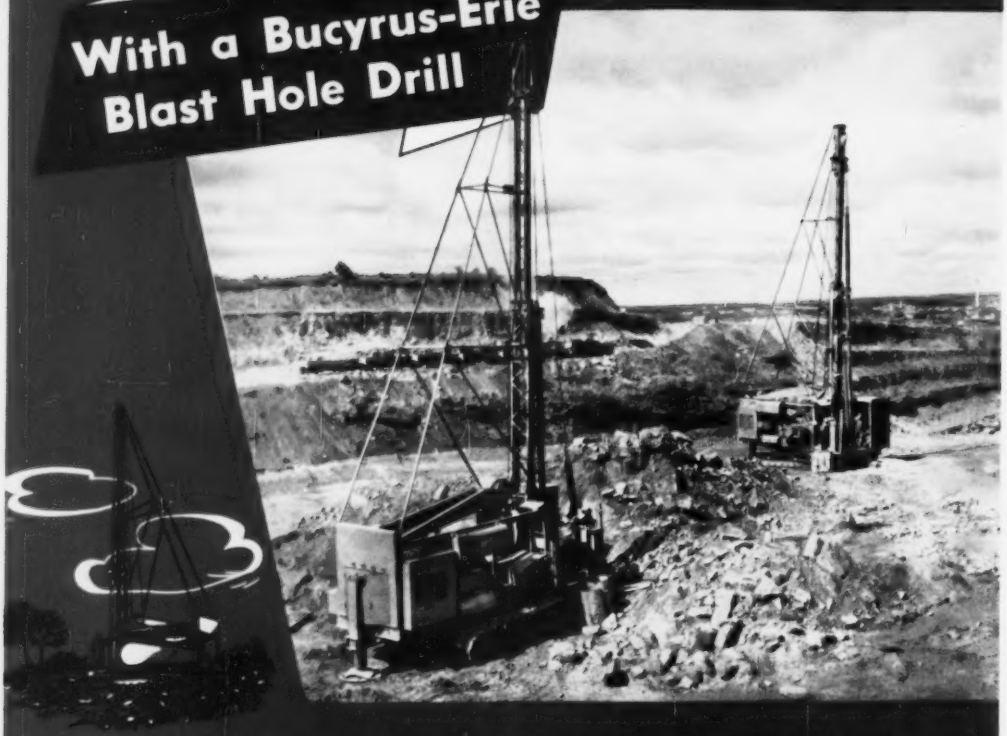

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[illegible] for jackshaft keep pinion bearings in alignment, relieving wear on pinions and gears.

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OSCAR EDWIN BENSON

## Oscar Edwin Benson

PRESIDENT

THE GENERAL CRUSHED STONE COMPANY

### A Biography

THE CAREER of Oscar Edwin Benson, president of The General Crushed Stone Company, offers another example of the success that comes from the application of engineering and administrative talents, hard work, an attractive personality, and a warm appreciation and understanding of his fellowmen.

"Ben," as he is known to his friends, was born in Wharton, Potter County, Pennsylvania, October 4, 1898, the son of John B. and Augusta (Anderson) Benson. His father was a railroader, as were a grandfather and six of his seven uncles. When John Benson retired in 1940, after thirty-two years of service as roadmaster for the Pittsburg, Shawmut & Northern Railroad Company at St. Marys, Pennsylvania, he had completed fifty-seven years of continuous employment with railroads in New York and Pennsylvania.

Ben obtained his elementary education in grade schools at Wellsville and Hamburg, New York, and at Penfield, Dubois, and St. Marys, Pennsylvania. The variety in the schools he attended was due to the family's moving to different communities as the father's job locations changed. He was graduated from St. Marys High School with the class of 1916.

During early school years, Ben developed a flair for mechanical drafting and architectural designing—some houses in St. Marys and various projects in other communities were built from plans he drew. At fourteen, he was remarkably proficient at handling a transit. Vacations from high school and after graduation found him working as a transitman and as general foreman of the maintenance-of-way department of the Pittsburg, Shawmut & Northern Railroad Company.

After graduating from high school, Ben took a course in mechanical drafting at Detroit Technical School, after which he enrolled at Dickinson College, Carlisle, Pennsylvania. During his freshman year at Dickinson, he was inducted into the United States Army. The coming of the armistice soon afterward cut short his military experience. Subsequently, he took engineering courses at Cornell University under a study-and-work arrangement made possible by the excellent engineering background he had acquired in working with railroad engineering and construction crews on a variety of assignments.

In 1924, Ben took a job as draftsman and transitman with Empire Gas & Electric Company at Geneva, New York. One year later he was made construction superintendent in charge of building electric and gas transmission and distribution lines, gas plants, and electric substations. When the Empire organization was merged with other public utility companies to form New York State Electric & Gas Corporation, Ben became operating superintendent for the corporation at Auburn, New York, in 1930. Nine years later, he was transferred to Ithaca, as division operating superintendent. In 1942, he was moved to Easton, Pennsylvania, as division manager for Metropolitan Edison Company. Four years later, he was elected a vice president of the company with headquarters at York.

In June, 1947, he resigned from Metropolitan Edison to accept the position of assistant to the president of The General Crushed Stone Company, Easton, Pennsylvania. Five months later, he was made vice president and general manager of the company, and in February, 1951, he was elected president.

Mr. Benson is a director of the National Crushed Stone Association; a member of the advisory committee for the stone industry in the Office of Price Stabilization; first vice president of the Chamber of Commerce at Easton; a director of Hotel Easton; chairman of the associate alumni board of Lafayette College; and a national representative of the Boy Scouts of America. He has served as general chairman of local Community Chest and hospital drives, and has been prominently identified with campaigns for the Red Cross and Lafayette College. His clubs include the Pomfret, Northampton County Country, Shrine, Elks (a life member), and Maroon of Lafayette College.

Oscar Edwin Benson married Olivette Saltsman, September 6, 1919, in Dubois, Pennsylvania. They have two sons, John and Robert, both with four-year-service records in the Army Air Force, World War II. At present, John is with the Air Force in Washington, D. C., and Robert is in the publishing and printing business in Penn Yan, New York. The Benson family home address is Rural Delivery No. 1, Riegelsville, Bucks County, Pennsylvania.

Ben's principal hobby is sail fishing. His sixty-two-acre farm provides opportunities for relaxation, and he often feels an urge to write a book entitled "How Little Can You Know About Farming?"

# Editorial

## A Vital Role Well Played

The role of minerals is one of the most vital in the national emergency production program. It is gratifying to note, therefore, that the mineral industries, despite unfavorable publicity at times, met the nation's requirements in 1951 in practically all categories with a larger production record than in 1950.

A recent announcement by Secretary of the Interior Oscar L. Chapman, based upon a summary prepared by the U. S. Bureau of Mines, discloses that the mineral industries in the United States increased overall production in 1951 by about 10 per cent over 1950. Also, the Bureau's report indicates that another substantial increase in tonnage is in prospect for 1952.

It is of interest that approximately 75 per cent of the nation's mineral production, in terms of total value, consisted of fuels, with petroleum contributing the largest share. The estimated demand for crude oil in 1951 rose to 2,725 million barrels, almost 10 per cent more than in the preceding year. Exports last year were 40 per cent higher than in 1950, partly as a result of the shutting-off of the supply of Iranian oil at midyear, while domestic demand increased about 8 per cent. To supply this record output, the industry produced 14 per cent more crude than in 1950, and more than in any previous year. The number of wells drilled by the industry totaled 44,000, a greater number than ever before.

Bituminous-coal production, which accounted for approximately one-fifth of the total value of minerals in 1951, rose about 4 per cent over 1950—from 516 million tons to 535 million tons. If export shipments continue at expected high rates, bituminous-coal production in 1952 should expand further. Exports of anthracite moved up from 3½ million tons in 1950 to about 6 million tons in 1951. While this increase was not sufficient to prevent a decline of about 6 per cent in the total tonnage output, the industry produced all that was required of it.

Iron-ore production in 1951 was 126½ million tons, up from 109 million tons in 1950. Record quantities were mined and recovered from the Mesabi deposits and moved via the Great Lakes and railroads.

Copper reached a mine-production total of about 950,000 tons in 1951, against 909,000 tons in 1950. The output for last year would have been about 25,000 tons higher if work stoppages had not curtailed production in the third quarter.

Zinc production approximated 685,000 tons in 1951, a rise of about 10 per cent over 1950, and the highest annual tonnage since 1944. Lead production figures indicate a decline for 1951. Both zinc and lead production are expected to increase considerably during the next three years.

The present outlook is for more minerals in the immediate future. There is no question that the mineral industries have the ability, the manpower, and, most of all, the will to produce in the quantities required by America and her friends.

## Outlook for Construction

H. E. Foreman, managing director of The Associated General Contractors of America, announced recently that an all-time-record total construction volume of approximately 39 billion dollars was put in place in the United States in 1951. Of this huge total, about 30 billion dollars was required for new-construction projects and 9 billion dollars for general maintenance and repair work.

Commenting that a total construction volume approximating 37 billion dollars is possible in 1952, Mr. Foreman indicated that construction activity during this year will be spotty, with peak levels of work in some areas and severe drops in others, depending on the types of construction, the distribution of materials, and the administration of construction controls.

In conclusion, Mr. Foreman advised public and private agencies to keep their planning programs alive, so that the possibility of a serious lag can be prevented when permission to go ahead with their plans is granted.

## The Minerals Yearbook

A new volume of the Minerals Yearbook, published annually by the U. S. Bureau of Mines, is now available for distribution to interested persons.

This issue, made up of 1,635 pages of text, plus a 26-page index, contains complete data for the year 1949, as well as comparative data for earlier years. The commodity reviews, written by specialists in their respective fields, deal with metals, nonmetallic minerals, and mineral fuels.

Bound copies may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for $4.50 each. All of the chapters of the book can be supplied as individual preprints. Copies of the preprints are also available from the Superintendent of Documents at from 5 to 30 cents each.

## DON'TS

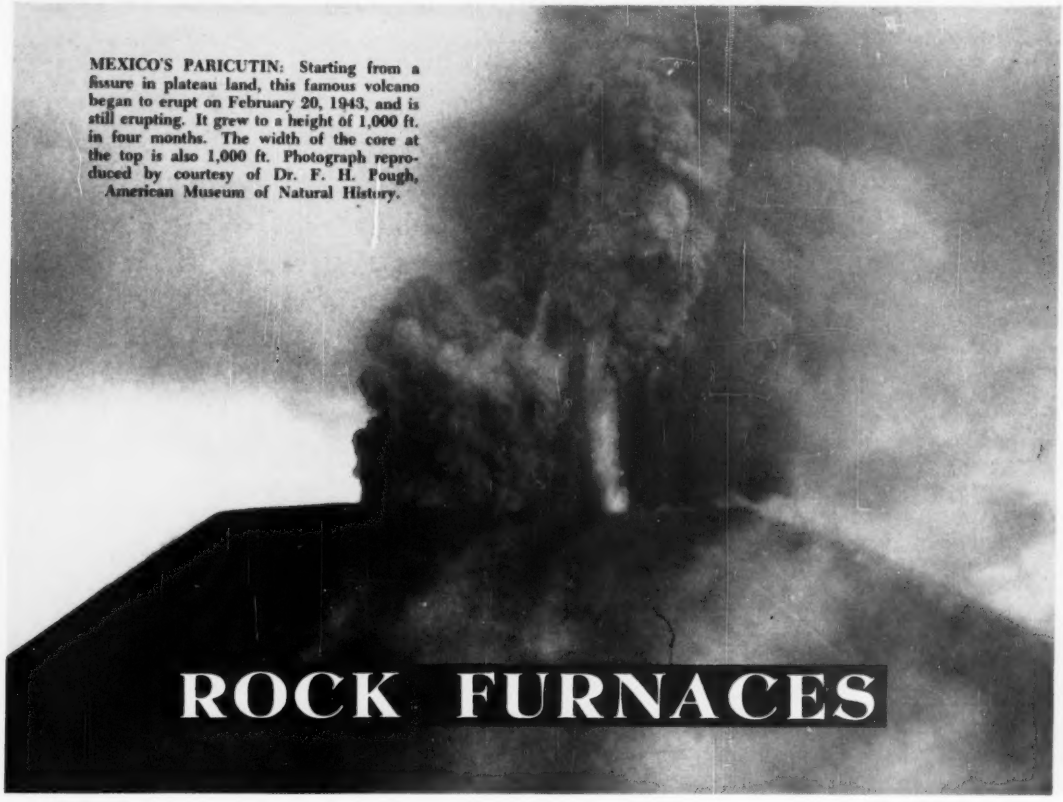
Don't drop, throw, or slide packages of explosives or handle them roughly in any manner.

Don't store any metallic tools or implements in an explosives magazine.

Don't allow persons under eighteen years of age to handle or use explosives or to be present where explosives are being handled or used.

Don't leave explosives lying around where children can get them.

Don't carry explosives in pockets of clothing.



MEXICO'S PARICUTIN: Starting from a fissure in plateau land, this famous volcano began to erupt on February 20, 1943, and is still erupting. It grew to a height of 1,000 ft. in four months. The width of the core at the top is also 1,000 ft. Photograph reproduced by courtesy of Dr. F. H. Pough, American Museum of Natural History.

# ROCK FURNACES

**The heat of volcanoes is produced by the breakdown of radioactive atoms many hundreds of miles below the surface of the earth**

C. W. WOLFE*

Volcanoes like Mexico's famous Paricutin have always captured the imagination of mankind. Apart from the violent damage that sometimes results from their eruptions, they provide the geologist with a clue concerning the interior of the earth which he can never reach directly. He sees a liquid of perhaps 1,800 to 2,500 degrees Fahrenheit pour out upon the surface of the earth where it congeals to form solid rock. Such liquids which form within the earth and which may solidify to form solid rock are called *magma*, and rocks which are thus formed are termed *igneous* rocks. Every geologist knows that this type of rock is by far the most abundant in the solid rock shell which forms the outer section of the earth. He consequently faces the problem of the source of all the magma that has made the igneous rocks.

From a study of earthquakes, we have learned that there certainly is not a liquid or magmatic shell below the outer rock shell. As far as we now know, the earth is solid to a depth of 1,700 miles. Below that depth, there is probably liquid iron and nickel, but since our magmas are not iron and nickel, we can be fairly certain they have not risen from the core of the earth. (Figure 1.) If, then, the earth is solid in the zone from which our magmas finally rise, we must conclude that magmas are being made gradually from day to day out of solid rock below the solid exterior shell. Rock is converted into magma which is transported to another place and cooled. There it becomes rock again, and igneous rocks are born.

*Boston University,
College of Liberal Arts,
Boston 15, Massachusetts.

### Furnaces Beneath the Surface

But how may rocks be converted to magma? From where comes the heat that transforms the solid into a liquid? The answer, which was suggested many years ago, is that there are furnaces beneath the surface which

are stoked, not by coal, but by the breakdown of radioactive atoms. It is commonplace knowledge today that when atoms split, either spontaneously or through man's activity, energy is released. Uranium and other elements have atoms which split and release energy. If this energy is released within rocks, it becomes manifested as heat. Thus, it is suggested that magma is formed when the heat produced by radioactivity is generated faster than it is dissipated by conduction to the earth's surface, and the rocks are warmed almost to, if not to, their liquefaction temperatures.

Three years ago it was suggested by the author in a paper before the Geological Society of America that this warming would result in an expanded subsurface sector which he called a blister. He believes that magmas are born in these blisters. Many tests of the radioactive content of rocks have been made. These seem to indicate that heat is being generated more rapidly in many areas than it is flowing out to the surface and being lost from the earth by radiation. There are but two ways that are ultimately available for the dissipation of the heat which is generated in these radioactive furnaces. It may be conducted to the surface through the solid rocks above, or magma which carries the heat from the blister area may be forced upward into the crust or flow out upon the surface of the earth. Both processes are active, but conduction is inadequate to take care of the total heat produced. Rocks are very poor conductors of heat, and they conduct heat even less readily when they become warmed. Heat continues to accumulate below the surface area, and the blister area which thus forms enlarges both horizontally and vertically. If any section of the blister becomes transformed into magma, it is apparent that the nature of the magma will depend upon the nature of the rock in that section of the blister which is converted into magma. Figure 2 shows a generalized picture of the character of the rocks in the crust and in the asthenosphere. Fractures which lead upward from the various levels may serve as channel ways for the rise of different kinds of magma to the surface.

### Homogeneous Heterogeneity Of Igneous Rocks

One of the outstanding features of igneous rocks is a homogeneous heterogeneity. Igneous rocks show many dissimilarities in their compositions and mode of formation. If one visits Yellowstone Park and looks at the volcanic rocks there, one will see light and dark rocks whose compositions differ considerably. The volcanic rocks of Abyssinia, those of the Deccan Plateau in India, the extensive lava flows of the Columbian Plateau, and those of the Hawaiian Islands all show interesting differences but, at the same time, remarkable similarities. The blister hypothesis would suggest that the major differences are largely the result of tapping of different levels of a blister. The radioactive furnace may be operating at depths of 10 miles or 50 miles to perhaps 400 miles. The type of magma which is produced, therefore,

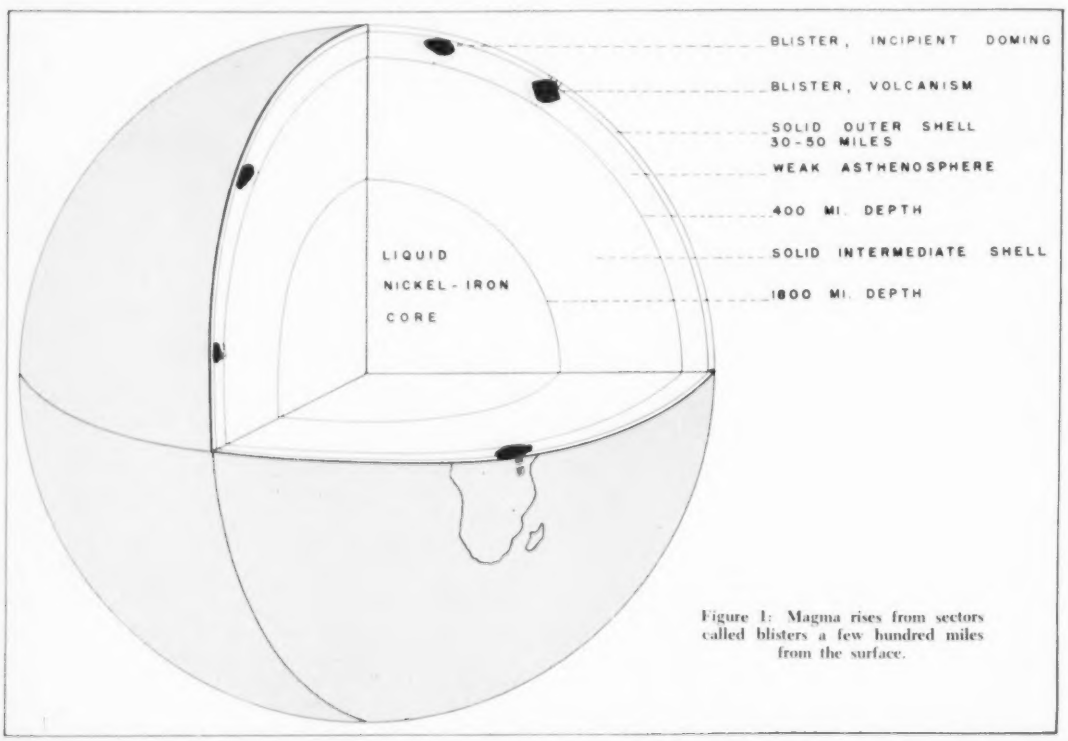



Figure 1: Magma rises from sectors called blisters a few hundred miles from the surface.

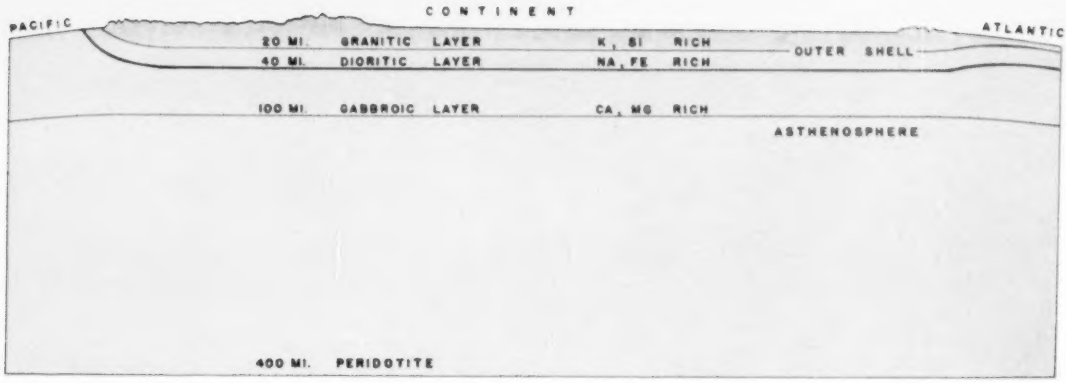



FIGURE 2: This represents the generalized stratiform character of the earth's outer crust and the asthenosphere.

depends primarily on the level from which it is derived.

There is much reason to suppose that the earth is layered even within the section which lies between the surface and a depth of 600 miles. (Figure 3.) The upper layers tend to approach the composition of granite; the lower layers become progressively enriched in calcium and magnesium until they are similar to the materials in the diamond pipes of South Africa, peridotite. When cracks develop above the blister, they may reach down to any depth in the blister before they reach a section which is sufficiently warm to be transformed into magma as the pressure diminishes in the cracked area. From that level, with its unique composition, the magma rises toward or to the surface and ultimately solidifies. The cooling which accompanies this removal of magma brings the volcanic episode above the blister to a close until more heat accumulates, causing the blister to expand and crack the roof again. This time, perhaps, the cracks will reach to a different depth, where a different composition of magma will be produced. Thus, variable types of magmas and igneous rocks develop above the blister. After the magma is produced, it may differentiate somewhat before it finally solidifies, but the principal magmatic types are assumed to form as described in this article.

### Magma Formation

Eventually the warmed blister region becomes very extensive horizontally and reaches the region of great troughs in the earth's surface which have gradually filled with sediments. The invasion of higher temperatures into this region results in a much more complex series of magma types. In general, four stages of magma formation may be recognized. The first stage involves the extrusion and intrusion into the trough area of magmas from

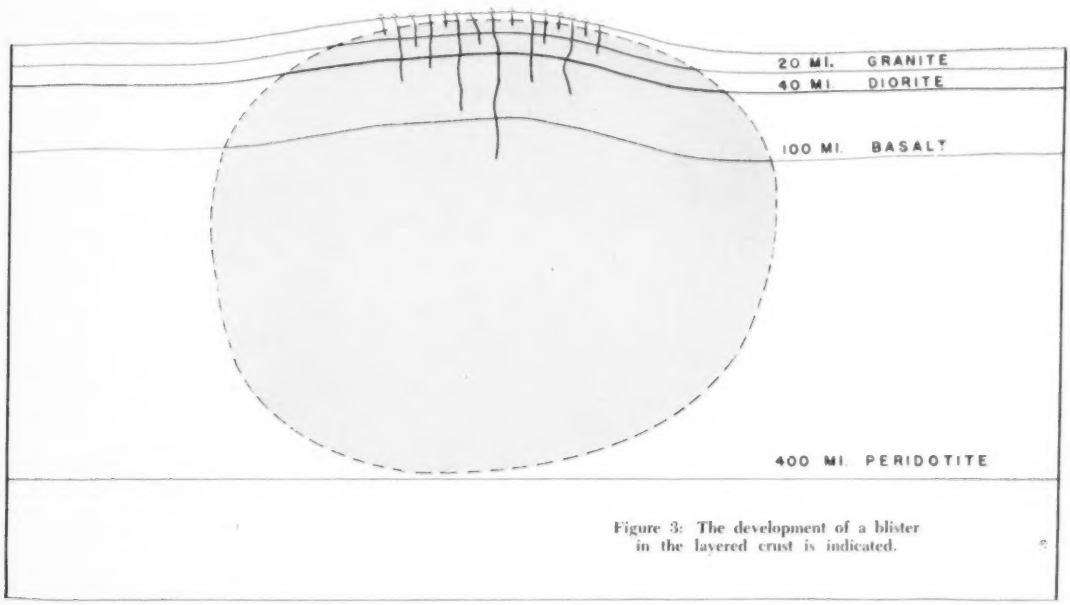



Figure 3: The development of a blister in the layered crust is indicated.

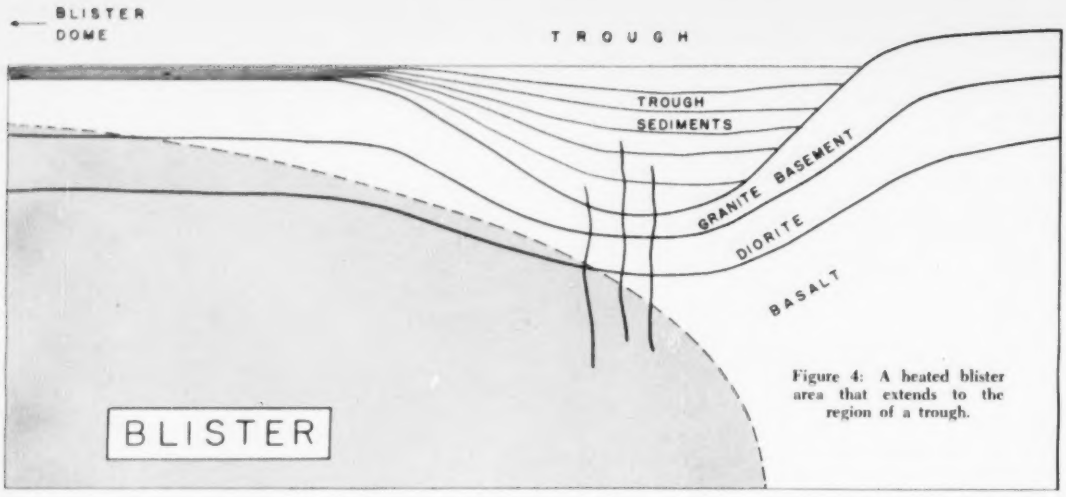



Figure 4: A heated blister area that extends to the region of a trough.

deep-seated sources. As the heat energy which is produced by the disintegration of radioactive elements continues to concentrate in the blister area, the temperature in the trough increases until the sediments in the lower part of the trough and basement beneath them are converted into magma, many of them being transformed in place, only to solidfy in the same position at a later date. The nature of the igneous rocks produced in this way is principally dependent upon the nature of the sediments which are transformed into magma and upon the degree of that conversion.

At about this stage, mountain building on a large scale begins as the sediments and basement are squeezed and compressed. The magmas, which are already available from the transformation of the basement and bottom sediments of the trough, are forced by the mountain-building stresses into the overlying sediments forming igneous rocks of highly variable composition, depending upon the source of the magma.

The mountain-building forces are visualized as stemming from a flattening of the expanded but collapsing blister rod. When mountain-building forces cease, that is, when the blister has totally collapsed, some magmas still remain fluid. These remaining magmas rise toward the surface by actually dissolving and plucking the roof materials. As each piece of the roof material falls into the magma, the level of the magma rises to replace the fallen blocks. The materials which drop into the rising magma chamber contaminate the already-complex magma, and complicated hybrid magmas are thus formed. These may or may not reach the surface as volcanic rocks, but definitely do eventually solidify to form igneous rocks.

### Final Episode in the Cycle Of Igneous Activity

As a final episode in the cycle of igneous activity in the trough region, magmas from deep-seated sources are once more extruded upon the surface. Prior to this final stage, the deeply folded sediments and basement rocks

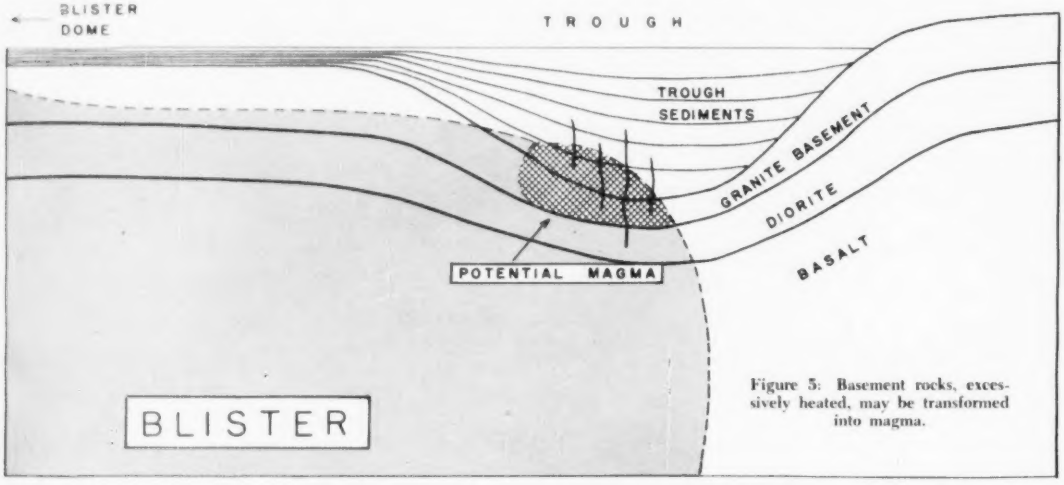



Figure 5: Basement rocks, excessively heated, may be transformed into magma.

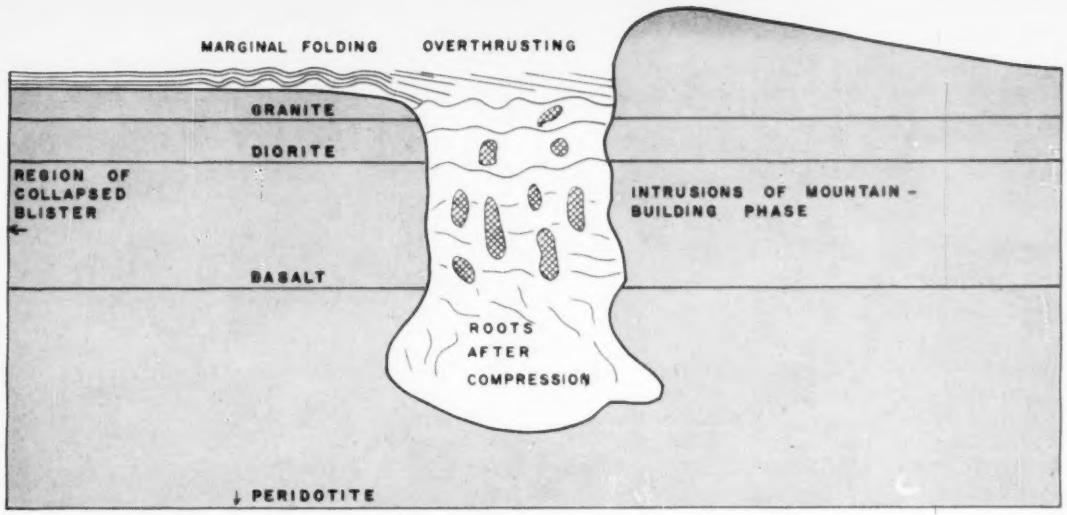



FIGURE 6: In a compressed trough region, magma is forced into sectors by mountain-building forces.

begin to float upward in a series of blocks. Since the sediments and basement rocks weigh much less, relatively, than the asthenosphere into which they are squeezed, the upward floating must take place. The magmas of the final phase move upward from the depths along the cracks between the different rising blocks.

According to the blister hypothesis, the volcanic rocks of the Sahara Desert represent those which form above a cracked blister roof, as do those of the Hawaiian Islands and those of the Colorado Plateau. The igneous rocks that are formed in the great chains of volcanoes which surround the Pacific represent the activity which accompanies the rising of the folded blocks in those regions. This is true, likewise, of the volcano-studded islands of Java and Sumatra. The igneous rocks to be found in the White Mountains largely represent those which form in a sinking and, later, folding trough, the first and second igneous phases of the trough regions. Since the igneous rocks of the White Mountains are of the order of 300 million years old, we may believe that the same general activity of magma formation which is visualized as acting today was also active in those ancient times.

### Conclusion

Thus, the blister hypothesis attempts to explain the occurrence of igneous rocks in time and space. The smouldering heat generation of the uranium atoms in the crust of the earth is visualized as primarily responsible for the slow but ever-recurring cycle of igneous activity. From this heat in subterranean furnaces, called blisters, magmas are formed, which sooner or later must reach the surface of the earth to bear witness to the processes that are active below to change the face of the earth.

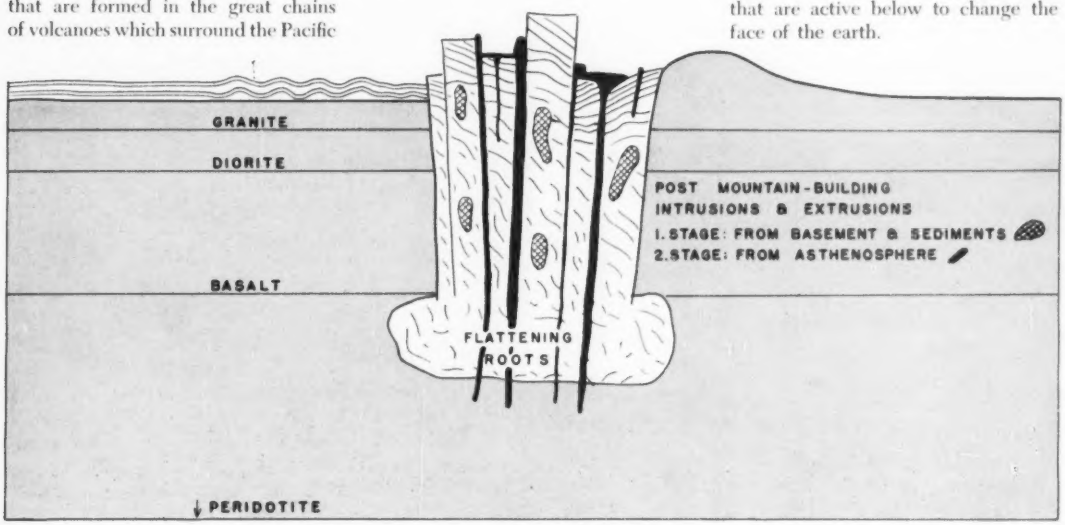



FIGURE 7: During the mountain-building phase, roots of lighter material float upward along vertical fissures.

# FOR QUARRY SAFETY

**Columbia No. 1 Quarry wins The Explosives Engineer plaque**

THE EXPLOSIVES ENGINEER AWARD
TO THE QUARRY OPERATED BY A MEMBER OF THE NATIONAL CRUSHED STONE ASSOCIATION HAVING THE BEST RECORD IN THE NATIONAL SAFETY COMPETITION
WON BY

One of the high lights of the 35th annual convention of the National Crushed Stone Association in Chicago, February 17 through 20, was the award of THE EXPLOSIVES ENGINEER plaque to Columbia No. 1 Quarry, Columbia Quarry Company, Krause, Monroe County, Illinois, for the best safety record among member quarries of the association for the year 1950. The winning record was 228,758 man-hours of operating time during the year without a lost-time injury.

The award of the plaque was made at a luncheon-ceremony in the Boulevard Room of Chicago's Conrad Hilton Hotel, by C. A. Gustafson, chairman of the N. C. S. A. Accident-Prevention Committee, to E. A. Heise, superintendent of Columbia's No. 1 Quarry.

Fifteen other quarries, members of the association, achieved perfect safety records in operations during 1950, and were honored by the awards of engrossed certificates to the superintendent of each quarry by Mr. Gustafson. The records of these fifteen quarries that were operated with no lost-time accidents in 1950 are listed below in the order of man-hours worked.

## CERTIFICATE WINNERS

FIGURES REPRESENT NUMBER OF ACCIDENT-FREE MAN-HOURS WORKED

Kimballton Lime Mine
The Standard Lime and Stone Company
Kimballton, Giles County, Virginia — 172,964

Plant No. 1 Limestone Quarry
Callanan Road Improvement Company
South Bethlehem, Albany County, New York — 115,412

North Branford No. 7 Trap Rock Quarry
The New Haven Trap Rock Company
North Branford, New Haven County, Connecticut — 95,890

Gibsonburg Lime and Limestone Quarry
The Kelley Island Lime and Transport Company
Gibsonburg, Sandusky County, Ohio — 88,433

Watertown Limestone Quarry
The General Crushed Stone Company
Watertown, Jefferson County, New York — 82,495

Martha Limestone Quarry
Marquette Cement Manufacturing Company
Lebanon, Wilson County, Tennessee — 74,075

Oriskany Falls Limestone Plant No. 5 Quarry
Eastern Rock Products, Incorporated
Oriskany Falls, Oneida County, New York — 71,588

Auburn Limestone Quarry
The General Crushed Stone Company
Auburn, Cayuga County, New York — 68,848

Jordanville Limestone Quarry
The General Crushed Stone Company
Jordanville, Herkimer County, New York — 64,295

Middlefield No. 1 Trap Rock Quarry
The New Haven Trap Rock Company
Middlefield, Middlesex County, Connecticut — 53,683

Marquette Limestone Quarry
Marquette Cement Manufacturing Company
Cape Girardeau, Cape Girardeau County, Missouri — 45,112

Plant No. 4 Trap Rock Quarry
Southwest Stone Company
Knippa, Uvalde County, Texas — 35,759

Prospect Limestone Plant No. 6 Quarry
Eastern Rock Products, Incorporated
Prospect, Oneida County, New York — 21,072

McCoy Limestone Quarry
Warner Company
Bridgeport, Montgomery County, Pennsylvania — 26,416

Pearisburg Hydrated Lime Quarry
Ripplemead Lime Company, Incorporated
Ripplemead, Giles County, Virginia — 12,398

# A Unique Harbor Development

## IN SAN DIEGO'S MISSION BAY

**Completion of a $23,000,000 construction program in 1960 will control the flow of a river, improve a harbor, and convert 1,800 acres of land to useful purposes**

ROBERT LEE BEHME*

STARTING high in the Laguna Mountains, the San Diego River meanders down through two dams built on the main fork of the river 25 miles distant from the City of San Diego. From that point, the river rolls through sparsely populated areas gathering mud and silt en route, and finally swirls past San Diego's "Old Town" to the bay.

At the mouth of the river in Mission, the silt of many centuries has piled up in flat drifts like sand dunes, making the shallow bay—2 to 3 ft. in depth—virtually useless. To the city's planners, this 1,800-acre area of flat land could be converted to useful purposes. The U. S. Army Corps of Engineers realized that the San Diego Bay, crammed with essential government and wartime developments, had forced the owners of small pleasure craft out of the only available harbor in the area. At the same time, the Army Engineers knew that the San Diego River had, in the past, become an active source of floods during periods of extreme rains. They were convinced that the construction of a channel to control the San Diego River would serve two useful purposes. First, it would provide a safety factor of flood control for the highly industrialized 10-square-mile area adjacent to the river's course, where aircraft factories and important Marine, Naval, and other government installations were located. Second, the channel would carry the silt in Mission Bay direct to the sea, leaving the bay area available for exploitation.

Early in 1945, the citizens of San Diego overwhelmingly voted for the passage of a $2,000,000 bond issue, which enabled the city to begin construction operations on its share of the proposed $23,000,000 project.

FROM THE AIR: This aerial view of the project shows the cut made through the middle jetty so that the dredge *Dallas* could move in and out of the harbor area.

At first, plans were developed separately by the city officials of San Diego and by the Army Corps of Engineers. Later, joint meetings were held to coordinate the efforts of the two groups. Final plans called for the Corps of Engineers to construct the floodway channel and dredge the outer harbor area including the dredging of Quivera Basin and Mission Harbor. These sections were scheduled for deeper draft, to accommodate the moorage and repair facilities for the larger pleasure craft. San Diego was to provide some financial support of the Army's project and to assume responsibility for the dredging of the rest of the bay, as well as for certain bridges and all landscaping of 1,800 acres of useless land.

Within a short time, the preliminary planning was completed and construction work could begin. The city had envisioned the time when Mission Bay would provide millions of dollars in yearly revenue from land leases, boat repairs, recreation rentals, and increased real estate values.

### The Macco Contract

Late in 1947, the Macco Company of Paramount, California, under a

*8260 Melrose Avenue,
Los Angeles 46, California.

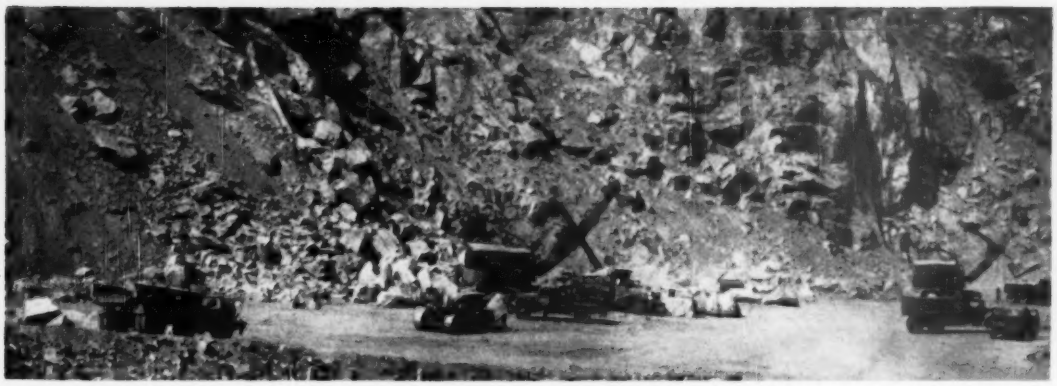
THE FLETCHER QUARRY: More than 800,000 tons of granite were blasted from this quarry face by the Macco and Atkinson companies to supply various sizes of stone for their Mission Bay Harbor contracts.

$1,940,000 contract with the Corps of Engineers, United States Army, began the construction of two of three jetties—the middle jetty and the downstream, or south, jetty—at the entrance to Mission Bay Harbor.

Macco crews, under the direction of Superintendent William Leece, moved into the area. The specifications in the contract called for 120,000 tons of core stone, varying in weight from 20 pounds to ½ ton; 50,000 tons of Class A stone, weighing from 500 pounds to 2 tons; 170,000 tons of Class A-1 stone, weighing from 1 to 12 tons; and 20,000 tons of Class A-2 stone weighing from 1 to 12 tons, 50% of which had to weigh 12 tons in order to be acceptable for use on the outer jetty edges. The stone was to come from the Ed Fletcher quarry, located 14 miles from the bay. On a subcontract with Macco, J. B. Stringfellow Company of Riverside, California, arranged to haul the stone from the Fletcher quarry and to place it at the jetty sites.

Moving into the quarry, Macco's quarry foreman, Earl Addington, began operations. The quarry had been worked previously, but only to the extent that evidence of rock formation was visible. After the quarry face was stripped and made ready for primary blasting, Addington and his men began work on driving a tunnel for a coyote blast. The equipment included three

COYOTE BLASTING: Under the thin cloud of dust that followed a coyote blast by Macco crews in the Fletcher quarry, a sloping bank of broken stone is piled up on the quarry floor.



**SHOVEL OPERATIONS:** Macco workmen, operating power shovels, clean up the toe of the quarry working face and load blasted granite into J. B. Stringfellow's trucks.

500-c.f.m. compressors, three wagon drills, six jackhammers, and one wagon jack, all Gardner-Denver units.

The rock at the quarry was a hard, blocky granite, dark blue in color. Because of this blocky formation, the majority of the stone resulting from blasts was in the form of boulders.

Starting at the base of the quarry face, Macco crews drilled, blasted, and excavated a tunnel straight into and through the rock for a distance of 65 to 70 ft. They then turned and drove two lateral tunnels, one to the left and one to the right, at right angles to the entrance tunnel. Each lateral tunnel was driven 100 ft. in length. The completed tunnels formed an almost perfect T. Quarrymen refer to this method of preparing a blast as the coyote method.

It was decided to load charges of Hercules® Black Blasting Powder into four pockets in each of the two lateral tunnels, making a total of eight separate charges. A loading factor of 0.95 to 1.25 of powder to 1 cu. yd. of rock and overburden material in the solid was used. A booster charge of 100 lbs. of 60% Gelatin Extra was placed in each of the eight powder charges. Wire-bound Primacord and Hercules® Electric Blasting Caps were used as primers, and the blast was fired with a 50-cap blasting machine.

In addition to the blast described, four other coyote blasts were fired by Macco. Each blast yielded approximately 80,000 tons of broken stone.

Rock requiring secondary blasting was drilled with Gardner-Denver jackhammers equipped with Timken 1¾ Carbaloy bits on 1-in. drill steel. The spacing of holes was governed by the

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**WELL DRILLING:** Clyde W. Wood used the well-drill method of blasting in the V. B. Dennis quarry to procure stone for his contract with the Army Engineers.

A 12-TON BOULDER: A close-up of a 12-ton boulder loaded on a truck for delivery to one of the new jetty sites under construction in Mission Bay Harbor.

size of the boulder. These drill holes were loaded with a handful of black powder, and the charges were fired with White Sequoi safety fuse.

### At the Jetty Sites

The blasted stone was loaded by power shovels into 10-wheel Ford dump trucks, owned by J. B. Stringfellow, and hauled to the two jetty sites. At the jetties, small- and medium-size stones were dumped into a specially constructed cable net, attached to a 1201 Lima power shovel. After the rock was dumped into the net, the shovel lifted the rock-loaded net over the side of the jetty, the bottom end was released, and the rock rolled down the side of the jetty into position.

Macco constructed the downstream, or south, jetty to a length of 1,500 ft., ending at the surf line in 25 ft. of water. The middle jetty, 3,770 ft. in length, ends in 40 ft. of water. Both jetties are carried on a 1½ to 1 slope to an elevation of 14 ft., with the tops 16 ft. wide.

Waste material from Macco's quarry operations was disposed of in Athey wagons hauled by Caterpillar D8's. At the start of work in the quarry, the waste was transported about 1,000 yds. to the San Diego River, where it was dumped into low spots in the stream. As the contract approached completion, waste material was dumped into depressions in the quarry floor.

While quarry operations were proceeding, Leonard Jones, superintendent of Macco's Paramount office, used a special scalping hook which he had designed for use on a previous job. Jones began experimenting with a scalping hook with the idea of preventing hazardous exposure of workmen. He kept a cost record on scalping with the hook as compared to the cost of men working as scalpers. Not only did the use of the hook prove economical, but it brought down additional pay rock which could not have been recovered by men.

The Macco Company completed the south jetty in November, 1948, and the middle jetty in December, 1949.

PLACING CAP ROCK: A special rock hook attached to a crane was used by J. B. Stringfellow on his contract to unload and place 12-ton boulders as cap rock at the jetty sites.

### The Wood Contract

Construction of the north jetty began in June, 1949, when Clyde W. Wood, Inc., was awarded the contract. The Wood Company's work on the north jetty was noteworthy because of the management's consistent introduction of special equipment to speed the work. This procedure was instrumental in bringing the job to completion two months ahead of schedule.

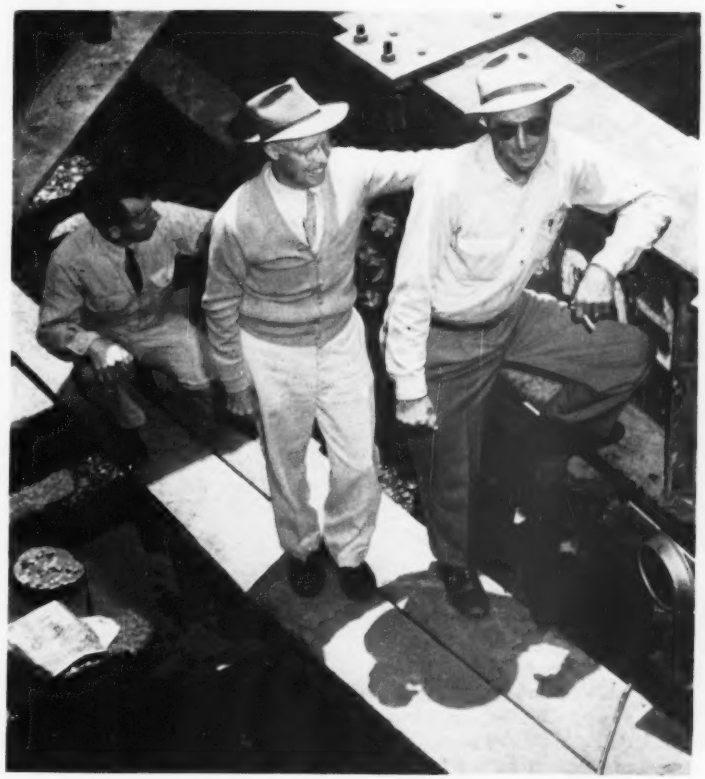
One of the first problems that confronted the Wood management in-

**INGENIOUS EQUIPMENT:** The problem of backing heavily loaded trucks on top of the 16-ft.-wide jetty in the Wood contract was solved by the contractor's designing, having built, and putting in use a 40-ft. steel turntable.

volved the backing of heavily loaded trucks on top of the 16-ft.-wide jetty, without the use of expensive turnouts. This was solved by Mr. Wood in designing and having built a 40-ft. steel turntable in his company's shops at North Hollywood. The turntable was transported to the jetty site and installed in place. It was operated by a 25-hp. air-cooled gasoline engine. Loaded trucks drove forward onto the ramp and, in 30 seconds, they reversed their direction and were in position to back up to unloading points. With the completion of each 100 ft. of jetty construction, a stone-placing crane pulled the turntable forward so that the truck drivers never had more than a 100-ft. back-up movement.

Mr. Wood had planned to use the conventional types of cranes for placing stone on the jetty. Later, he was told that the booming-out at angles lower than 75 degrees would pull the cranes off balance when picking up heavy stone. If this proved to be true, the company was faced with the necessity of purchasing up to $90,000 worth of special equipment. Again he turned to his North Hollywood shops for the solution and came back with the answer to the problem.

Wood's original plans called for using a regular Manitowoc 3000B which was in service as a 2-cu. yd.



**LEFT TO RIGHT:** L. B. Hershberger, office manager, Guy F. Atkinson Company; Tom Allen, project engineer for the City of San Diego; and Leland Cox, project superintendent, Guy F. Atkinson Company.

dragline. It was fitted with a 20-ft. steel track which tilted upward from the base of the rear of the operator's cab. A large steel box was made and placed on the track. When the crane arrived at the jetty site, the steel box was filled with 7 tons of steel punchings. The box was arranged on the track so that it acted as a counterbalance and automatically moved up and down to compensate for the carrying pulls of the crane boom. In this way, a conventional crane was converted into hammerhead equipment. The results were highly successful. The crews could boom out to angles as low as 50 degrees for pickups of 12-ton stone.

The Wood Company contract called for more than 380,000 tons of stone with about 135,000 tons of core stone and approximately 245,000 tons of 2-, 6-, 8-, and 12-ton stone. This material came from the V. R. Dennis Construction Company's quarry in the foothills of the Mission Gorge Valley near Macco's quarry. The rock at Dennis' property was an irregular dark basalt.

### At the Dennis Quarry

Work in the quarry began with squaring the east side of the working face. After this was done, the crews drilled, blasted, and excavated a tunnel 70 ft. deep into the face, under the direction of Andy Weesner, superintendent, and Harry Schultz, foreman. The operations were then directed to driving tunnels to the right and left, approximately at right angles to the main entrance tunnel. Each of the two wing, or lateral, tunnels was driven 100 ft. long (similar to the T-shaped Macco tunnels in the Fletcher quarry, described previously). Four pockets in each of the two lateral tunnels were loaded with carefully calculated charges of Hercules Black Blasting Powder. The charges were primed with 2,000 ft. of wire-bound Primacord and Hercules Electric Blasting Caps. The blast, fired with a 50-hole blasting machine, produced about 80,000 tons of broken stone.

Stone requiring secondary blasting was drilled with Gardner-Denver jackhammers. A handful of black powder was loaded into the drill holes and blasts were fired by means of White Sequoi safety fuse.

**HIGHWAY BRIDGE:** Auto traffic was so heavy during the construction of this Highway 101 extension bridge that a first-class roadway was built as a detour.

After the blast by the coyote method, Weesner changed drilling and blasting methods. The remaining 300,000 tons of stone needed for the jetty was broken in two ways: first, by the employment of a Bucyrus-Erie well drill, drilling 9-in.-diameter holes to depths of 45 to 60 ft. The spacing between holes varied from 21 to 30 ft., depending upon the type of rock formation encountered.

The well-drill holes were sprung with charges of from 10 to 100 lbs. of Hercules* 60% Gelatin Extra. After the holes had cooled, they were loaded with Hercules Black Blasting Powder on a ratio of 0.85 lbs. of powder to 1 cu. yd. of solid material. The bulk of the black powder was placed in the chamber in the bottom of the holes and the remainder was staggered in deck loads along the barrels of the holes. Detonation was accomplished by the use of reinforced Primacord and electric blasting caps.

During the last six months of quarry operations, the well-drill method was supplemented by drilling horizontal holes 24 ft. deep into the toe of the quarry face. These holes were loaded with Hercomite* Bag Powder on a ratio of approximately 0.6 lbs. per 1 cu. yd. of solid material.

After blasting, the stone was transported to the north jetty site by a fleet of 12 Autocar semidump trucks, owned by Wood. They were equipped with special rock bodies by Cook Brothers of Los Angeles, to carry 16 to 18 tons of stone per trip. Don Bridwell was truck foreman and Bonny Cameron was master mechanic.

### The Atkinson Contract

The Guy F. Atkinson Company began work on its $2,340,000 contract with the Army Engineers at the floodway channel section of the project. The channel extends for more than 3 miles, beginning at a high of elevation 101 and proceeding down to the Pacific Ocean. The company decided to procure its stone requirements from the Ed Fletcher quarry, which had been used as a source of stone supplies by the Macco Company. Atkinson arranged a subcontract with J. B. Stringfellow to haul the stone from the quarry and place it at the channel job site.

Under the direction of C. H. Thompson, project superintendent, Atkinson crews set up three wagon drills and ten hand drills, of Gardner-Denver manufacture, in the quarry. The height of the working face varied from 20 to 100 ft. Holes from 12 to 20 ft. deep, drilled horizontally on 4-ft. centers, were loaded with Hercomite Bag Powder. After successive blasts had been fired and the extreme variation in the height of the quarry face had been adjusted, a tunnel was driven,

(Continued on page 25)

*Reg. U. S. Pat. Off.

# BLASTING A RACEWAY CHANNEL AT ROCHESTER, NEW YORK

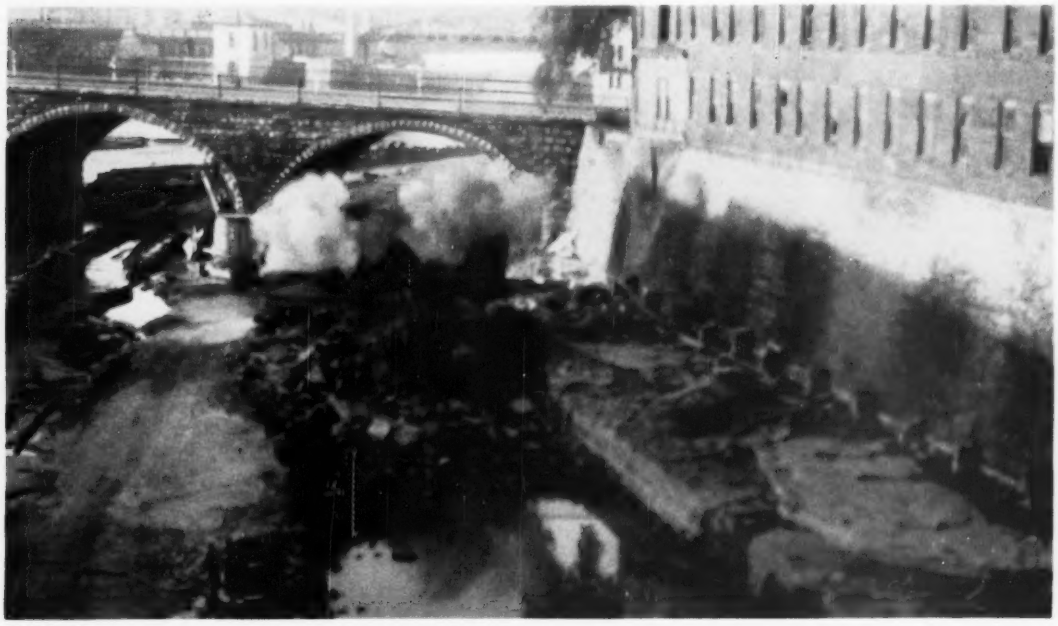
## Construction operations within city limits required extreme care in drilling and blasting

CARL P. DINTRUFF*

In 1802, three men from Maryland—Messrs. Carroll, Fitzhugh, and Rochester—purchased 100 acres of land along the banks of the Genesee River in upper New York State. They chose the site because of the potentialities inherent in the water in the river and local falls as a means of turning grinding wheels for flour mills. By 1832, a good-sized community had been developed, which the local settlers called Rochester. As activities were expanded, Rochester was recognized as one of the great milling centers in the world and became known as the Flour City. The official seal of the city still carries the inscription The Flour City, despite the fact that no flour mills have been located along the river for some time.

Prominent among the projects of the early settlers was the Carroll-Fitzhugh raceway. It was constructed along the west side of the river beginning south of Court Street and extending to Broad Street. Water from the river was carried through the raceway to various manufacturing plants in the area. The quantity of water distributed was controlled by the "rights" owned by each plant. This method of distribution resulted in many disputes and much litigation. Through the years, the water wheels became inefficient and, finally, were abandoned. In the meantime, most of the water rights were purchased by

*Hercules Powder Company, New York, New York.



BLASTING: Details of drilling and blasting were carefully calculated and executed because of the proximity of buildings and other structures.

EXCAVATING: After blasting, a power shovel and a fleet of automobile trucks quickly removed and disposed of the broken rock.

LINE DRILLING: The smooth, even walls in the area under a bridge is indicative of skillful line-drilling operations.

NEW PLANT SITE: Part of the river wall has been blasted and the muck will be excavated to clear a site for a new plant.

the Rochester Gas and Electric Corporation, and all the water passing through the raceway was used by R.G.&E. to run a small hydroelectric plant, known as Station 26.

### A Perplexing Problem

When the city officials of Rochester decided to erect a building as a war memorial at Exchange and Court Streets, the location of the raceway was a perplexing problem. Preliminary investigations indicated that the new structure would have to be built over the raceway. This involved a decided increase in the cost of the project. The city manager appealed to the president of Rochester Gas and Electric Corporation and the corporation agreed to close the raceway and relocate its Station 26 near the dam at Court Street. This neighborly action has been of great help in speeding the construction of the War Memorial to honor those who lost their lives in their country's service.

The contract for the construction of a new hydroelectric plant for the power company was awarded to A. Friederich and Sons Company early in May of last year. Bob Lewis, the contractor's general superintendent, started excavation proceedings on May 23, 1951, with a crew of men removing earth behind the river wall. The removal of the rock formation in the river bed was sublet by the Friederich Company to Rock Construction Corporation of Downsville, New York. The drilling and blasting details involved in this subcontract required careful operating procedures because of the proximity of buildings and other permanent structures.

Under the capable direction of Al Greenwood, superintendent for Rock Construction Corporation, the drilling of holes for blasting the rock in the river bed and the concrete river wall was started early in June. The details involved in removing the river wall were completed on June 22, 1951. Drilling in the rock in the river bed was started on July 13, 1951, a few feet south of Broad Street Bridge. Work progressed upstream under the last arch on the west end of Court Street Bridge and continued to about 100 ft. from Court Street Dam. At that point, operations were directed

**TYPICAL ROCK BREAKAGE:** Another view of a shovel at work in a bank of broken rock as operations approach Court Street Dam.

**INTAKE AREA:** After the rock in the intake area has been blasted and excavated, the river wall, shown at the left, will be removed.

away from the river bed to proceed into the area of the plant location.

### Drill Hole Spacings

Excavation in the plant area called for the removal of approximately 30 ft. of rock. Holes for blasting were drilled on various spacings, determined by the type of rock encountered and the breakage of the rock from blasts. The drill holes were loaded with 1¼ by 8-in. cartridges of Gelamite* 2 dynamite, and the charges were primed with Hercules* No Vent Short-Period Delay Electric Blasting Caps. All of the rock formation at this location was carefully line-drilled to insure a smooth, even wall for the free flow of water. The drill holes in this line-drilling phase of the project were spaced as close together as the equipment and operating conditions would permit.

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### Final Excavation Details

The rock encountered at the penstock and the intake area locations was the last to be drilled and blasted. These operations were completed on October 18, 1951. A comparatively small area of rock remains to be blasted and excavated on the north end of the tailrace. The river wall above the dam will be removed after completion of the concrete structures in the intake area and the new river wall west of the existing wall.

On Rock Construction Corporation's contract, the total number of cubic yards of rock removed was 17,900 and a total of over 60,000 feet of line drilling was accomplished. The drilling was accomplished by the employment of four Worthington wagon drills. Air for the drills was furnished by two compressors, a Worthington 500-c.f.m. and a Joy 600-c.f.m.

The supervisory personnel for Rochester Gas and Electric Corporation on this project includes John E. Fredericks, engineer; John Baker, general superintendent of construction; Paul B. Rombaut, engineer; Earl Stanton, inspector and layout; and Frank W. LaLonde, inspector. The directors of operations on the A. Friederich and Sons Company contract are Adam Friederich, president; Lewis Friederich, treasurer; and Robert Lewis, project superintendent.

**BLAST IN ACTION: The deck-loaded charges of 40% and 60% Gelatin dynamites have been detonated with short-period delay electric blasting caps and Primacord and the fractured rock is on its way to the ground.**

# Chimney Rock Quarry In New Jersey

## Expanded production at Bridgewater Township keeps pace with heavy demand for crushed stone

ALBERT S. KESHEN*

In writing this article about taking rock from a hill in New Jersey and putting it back into the ground at another nearby location in the state, the expression "robbing Peter to pay Paul" popped into the author's mind. Let me assure the reader that this rock switching concerns a movement for the improvement of existing conditions—the conversion of a basic raw material into a product for use in building a new, modern turnpike through a busy section of New Jersey, to speed the movement of thousands of commercial and private vehicles with a greater degree of safety, convenience, and comfort.

The first phase of this rock-moving story involves the operations of a quarry and plant of North Jersey Quarry Company called Chimney Rock, located at Bridgewater Township, Somerset County, New Jersey. The name Chimney Rock is derived from a geological formation in the first range of the Watchung Mountains that looms up in the shape of a chimney. This unusual formation has been a local landmark for years. Tradition has it that in the days before the coming of the white man, a love-thwarted Indian maiden flung herself from the top of this rock into the raging torrents below. The oddly shaped formation is painted white and stands out like a beacon over the countryside. It is a favorite spot for Sunday strollers and family picnics.

*58 Demarest Street, Newark 8, New Jersey.

### Chimney Rock Quarry

Some years ago, William Haelig built a hotel on Chimney Rock because of the public's unusual interest in the site. Shortly afterward, he realized the possibilities for a profitable side line in blasting and crushing a section of the rock for commercial uses. As the demand for crushed stone grew, his small quarry and plant operations were expanded. After Mr. Haelig's death, his holdings were sold to North Jersey Quarry Company, the present owners. The arch-shaped bluff assures a plentiful supply of trap rock for years to come.

North Jersey Quarry Company started large-scale operations in the Chimney Rock quarry about 1930. At present, the working face is 1,600 ft. long, 130 ft. high at the north end, and 200 ft. high at the south end. When the company received a contract several months ago for 900,000 tons of various sizes of crushed stone from George M. Brewster & Son, Inc., it installed modern equipment, time-saving machinery, and increased its working force. The stone was to be delivered to designated points along a 53-mile stretch of highway construction from Raritan to Moorestown, on the new 118-mile New Jersey Turnpike. The addition of 12 trucks brought the quarry company's total to 18; three extra power shovels increased the number of these units to eight; and three drills were put to work instead of one. The number of workmen was increased from 70 to 153. The addition of 12 employes in the office and at the plant scales brought the total working force to 165. The company's normal schedule of work hours a day was extended from 10 to 11½. One section of the plant was put on an operating schedule of 24 hours a day.

### Drilling and Blasting

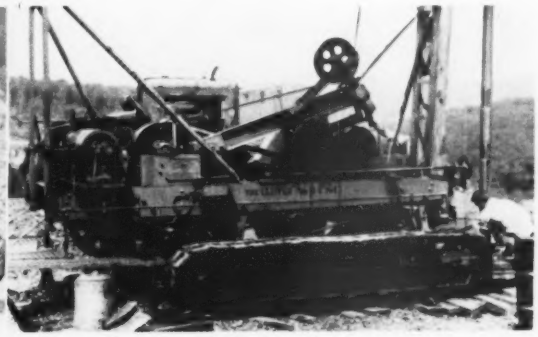
On top of the quarry face about 6 ft. of the rock is stripped of light shrubs and plant growth. Holes for blasting are drilled vertically into the formation, utilizing two crawler-mounted Bucyrus-Erie 29-T electric churn drills and one crawler-mounted Loomis Clipper. The two electric drill units, averaging about 2 ft. of hole an hour, draw the heaviest duty.

(Continued on page 26)

READY TO BLAST: Three 6⅞-in. well-drill holes, spaced on 26-ft. centers and an approximate 20-ft. burden, are loaded and ready to be fired.

AFTER THE BLAST: This sloping mound of broken rock represents a yield of approximately four tons of stone for each pound of dynamite loaded.

RECOVERING BLASTED STONE: One of George M. Brewster Company's power shovels was requisitioned to help load out broken stone in the quarry.



WELL DRILLING: A crawler-mounted Loomis Clipper churn drill being readied to drill a 6⅞-in. hole in the quarry face preparatory to blasting.

THE PLANT: A bird's-eye view of the stone processing units in the plant area. The office and shops are at left background.

# DRIFTWOOD

Call me a miner or call me a tramp,
I've been a little of each,
I've floated into many a camp,
And drifted upon the beach;
I've traveled from Salt Lake to Jerome,
The Comstock has known me, too,
Wherever I am I call my home,
And my trades whatever I do!

Drifting along, drifting along,
Floating wherever the tide is strong,
Going no place and everywhere,
No one to know and no one to care,
Getting in right or getting in wrong—
Drifting, drifting along.

I'm a Native Son or a Peerless Plug,
I'm a Notcher, I guess, as well,
And down in Nevada I have dug
In heat, hot water, and hell;
High-graded a bit down Goldfield way,
Gumbooted a bit in Nome,
My habitat's wherever I stay,
And wherever I am is home.

Drifting along, drifting along,
What do I care if you think it wrong?
I get my clothes and a drink or two,
And the rest of my life is nothing to you,
Floating wherever the tide is strong—
Drifting, drifting along.

Sometimes I work for a month or so,
Sometimes I work for a shift,
And when I'm ready and primed to go
I quit my working and drift;
Sometimes I land in the county jail,
And suddenly cease to roam,
For I have no cash and I get no bail,
So wherever I am is home!

Drifting along, drifting along,
Is the melody of my song,
When I die I reckon I'll drift
To a hot-box hole and an endless shift,
But still I'll go where the tide is strong—
Drifting, drifting along.

This poem was sent to THE EXPLOSIVES ENGINEER by a subscriber, F. A. Dalburg, Montoursville, Pennsylvania, who found it in old files covering his visits to mines in Santo Domingo, Peru, in 1916. A pencil notation at the bottom of the original reads "Alaska's Swiftwater Bill." The author is unknown.

## Harbor Development

(Continued from page 18)

under the supervision of Blackie Armstrong, quarry foreman. The tunnel was drilled and blasted to a depth of approximately 55 ft., after which two lateral tunnels, each 60 ft. long, were driven to the right and left of the main tunnel. Four pockets in each of the lateral tunnels were loaded with Hercules Black Blasting Powder, using a loading factor of about 1 lb. of powder per 1 cu. yd. of solid material. A booster charge of 100 lbs. of 40% Gelatin Extra was placed in each of the powder charges. Wire-bound Primacord and electric blasting caps were used as primers, and the blast was fired with a mobile lighting unit.

Atkinson Company crews employed the tunnel, or coyote, method in making five primary blasts in the Fletcher quarry and the results were uniformly satisfactory. Working two 8-hour shifts, the quarry crews produced an average of 2,000 tons of variable sizes of stone each working day.

When Atkinson's workmen moved onto the quarry property, they found a 200,000-ton spoil bank at the site. Most of this material was composed of smaller sizes of rock. The crews set up a grizzly and processed the spoil bank, retaining the larger sizes of stone for use at the jetty site. The grizzly was constructed of manganese incline bars with a split electric roller which provided controlled loading. The split roller was especially helpful in loading the different sizes of trucks.

Fifty per cent of the blasted stone was delivered to the grizzly where it was screened to remove the fines. The fines were used to repair local roads and to build new access roads to the quarry. Two Northwest 80-D's loaded blasted stone from the quarry into the trucks which hauled to the grizzly. A Caterpillar D8 was used to maintain road conditions, clean the pits, level the spoil area, and remove overburden.

The Atkinson contract specifications included the dredging of the pilot channels of the bay and the clearing of the flood-control channel.

### Dredging in the Bay

Dredging of Mission Bay, which involved the removal of 1,000,000 cu. yds. of materials, was started by Franks Dredging Company on March 22, 1950. The dredge *Dallas* was brought into the bay by removing the center span of the Mission Boulevard Bridge. It was taken direct to the northeast end of the project near the Ventura Avenue Bridge, which connects important sections of San Diego's outlying environs. Within a short period, 7,000 ft. of 18-in. pipe was laid from the dredge to the San Diego floodway site where the spoil would be used in levee work. Plans called for utilizing 500,000 cu. yds. of spoil for levees and the remainder for the reclamation of nearby lands.

On May 1, 1950, the dredging neared the final stages of work in the floodway, and the *Dallas* was moved into the Mission Bay area where some pilot dredging had been done.

An unusual feature of the dredging in the floodway section was the construction of a system of locks to provide flotation for the dredge. The *Dallas* had to maintain a 5-ft. draft minimum and a cross levee was constructed between the sides of the floodway east of the Mission Bay Bridge. Another cross levee was built near the Midway Bridge. Water was pumped over the levee to maintain the draft at all stations.

At the eastern terminus of the project, 200 ft. west of Highway 101, two power shovels, a Lima 800 and a Northwest 80-D, were put to work on the construction of a floodway stabilizer. The stabilizer was designed by the Army Engineers to prevent scoring when future flood waters rushed into the confined floodway.

Riprap quantities, which faced the levee from the stabilizer to the Pacific Ocean, included 57,500 tons of Class A stone; 44,500 tons of Class B stone; 15,000 tons of Class C stone; 108,500 tons of Class D stone; 200,000 tons of Class E stone; and 8,500 tons of Class F stone. This total of 434,000 tons of stone was installed over smaller core-filler material and used to prevent undercutting and slippage of riprap.

Under its subcontract with the Atkinson Company, the J. B. Stringfellow Company also handled the connection of the jetties to the Mission Bay Harbor entrance. This work was completed shortly after the dredge *Dallas* had finished with its floodway work and cut through the middle levee, to move into the harbor area.

During its work on the project, the Stringfellow Company trucks hauled all of the stone for both the Macco and the Atkinson operations. Using 10-wheel Ford trucks, Stringfellow frequently had more than 35 trucks in operation during a single shift. During the busiest periods of work on the jetty, the trucks made more than 130 trips a day to the quarries. In his rock-placing work on the jetties, Stringfellow used both a 1201 Lima power shovel and a 3000B Manitowoc crane.

### New Bridges

A contract to build three bridges spanning the floodway was awarded to the Guy F. Atkinson Company shortly after the floodway contract. Two of the bridges are for the City of San Diego and the third is for the State of California.

An extension to the Highway 101 bridge, which accommodates northbound traffic from San Diego to Los Angeles and San Francisco, is nearing completion. While construction was under way, the traffic was so heavy that Atkinson had to build a first-class highway as a detour route.

Work by the Army Engineers, which includes the floodway and dredging of the outer harbor area to a depth of minus 20 ft., is under the supervision of Colonel Walter D. Lupow, Los Angeles District Engineer, Corps of Engineers, U. S. Army; and William J. Leen, Chief of Operations Division, Los Angeles District. Gordon Lilley is the resident engineer on the project.

Tom Allen is project engineer for the City of San Diego. Work under his direction includes the dredging of the Mission Bay area excluded by the Army, as well as bridges and landscaping. B. E. McCowan is chief inspector for the city.

The supervision of the Guy F. Atkinson Company operations is looked after by C. H. Thompson and Leland Cox, project superintendents; L. B. Hershberger, job office manager; Blackie Armstrong, quarry superintendent; Jim Cox, assistant quarry superintendent; and J. J. Standish, levee foreman.

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LEFT TO RIGHT: Mark Fucci, chief electrician; William L. Henderson, plant superintendent; Jacob Reznick, mill foreman; Thomas Bird, quarry foreman.

## Chimney Rock Quarry

(Continued from page 22)

The bits on the drills are 6¾ in. in diameter. Smaller holes are drilled with an Ingersoll-Rand wagon drill and an I-R Jackhamer, powered by a stationary Ingersoll-Rand compressor and two portable Le Roi units of 500 and 315-c.f.m. capacities.

On the north end of the quarry face, holes 6¾ in. in diameter are drilled to the floor level; on the south end, they are drilled to the developing bench. The spacings between holes average 26 ft., with the burden in front of each hole about 20 ft. The usual procedure is to blast three holes at one time at intervals of two to three weeks, depending on production requirements in the plant. The holes are deck-loaded with 40% and 60% gelatin grades of dynamite in 5 by 24-in. cartridges. The charges are primed with short-period delay electric blasting caps and Primacord, and blasts are fired from a 440-volt shooting line. The charges are stemmed with ¾-in. size stone from the plant. Blasts average four tons of stone for each pound of dynamite loaded.

### Excavating and Processing

Five caterpillar-mounted Bucyrus-Erie power shovels are employed to recover the blasted rock—three 75-B electrics and two 54-B Diesels. They load into six gasoline-driven Mack trucks and twelve Diesel-powered end-dump Euclids that haul the stone to the plant and dump their loads into two 48 by 60-in. electrically powered Traylor jaw crushers, each geared to handle 500 tons an hour.

After preliminary crushing, the stone is moved along on a 48-in. conveyor belt with a handling capacity of 10,500 tons a day, to a 6 by 16-in. Robbins Gyrex screen where minus 2½-in. stone is screened out. The plus 2½-in. sizes are conveyed to two 5½-ft. Traylor Gyrex crushers for further reduction. After passing through

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these crushers, the stone is discharged into two 5 by 14-in. Robbins Gyrex screens. The stone screened out from this unit constitutes the bulk of the requirements on the Brewster Company's turnpike project. Over and under sizes of stone are conveyed to the west mill for further reduction by six crushers. From these crushers, the stone is screened, processed, and conveyed to separate sets of bins. Autotrucks and railroad cars are loaded from the bins for final deliveries to the company's customers.

The Central Railroad of New Jersey maintains a siding into the plant yard. Gasoline locomotives are used to move railroad cars in the plant yard. Browning locomotive cranes are employed to load the stone from the bins into railroad cars and autotrucks.

The Brewster Company's fleet of autotrucks hauls thousands of tons of crushed stone each day from the Chimney Rock plant to stock piles along the turnpike right-of-way and makes deliveries to the contractor's construction operations as needed.

Despite the heavy requirements of the Brewster contract, the plant has been able to take care of orders for crushed stone from other highway and building contractors, estate owners, and state, county, and municipal road maintenance departments.

### Company Activities

The activities of North Jersey Quarry Company are directed by John H. Schmidt, president; Edwin B. Havens, vice president, sales; Daniel J. Miller, chairman of the executive board; and H. A. Silsby, operations officer. The main offices are located at 10 Park Place, Morristown, New Jersey.

In addition to the Chimney Rock unit, the company operates stone quarries and crushing plants at Millington, Summit, and Bound Brook, and sand-producing plants at Lakewood and Netcong. It is associated with quarries and plants at Montclair Heights and Great Notch and a sand-production operation at Riverdale. All of the above locations are in New Jersey. Also, North Jersey Quarry Company maintains an associated relationship with Portland Sand and Gravel Company of Pennsylvania, located at Carpenterville, New Jersey.


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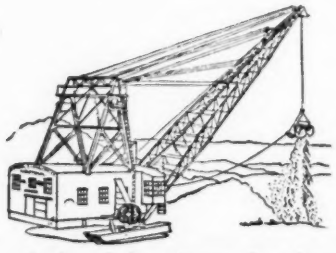

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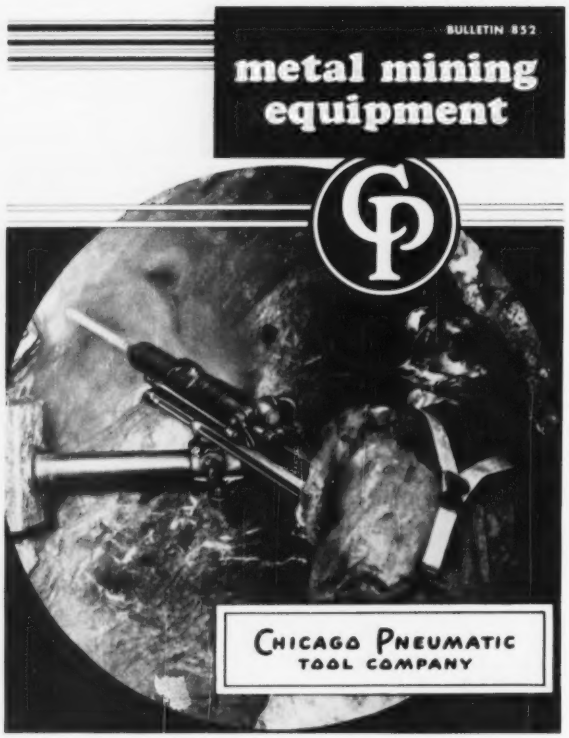


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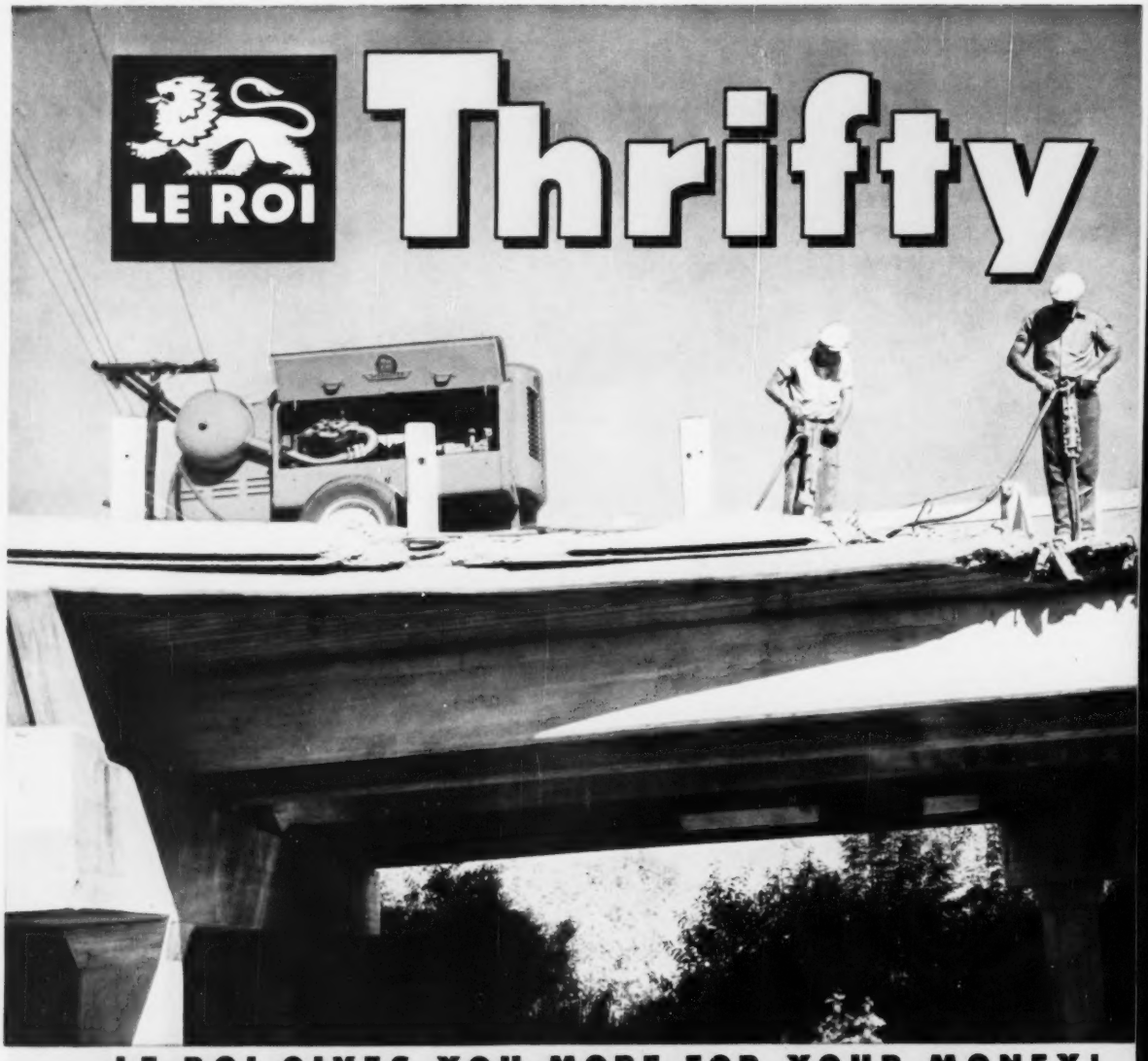

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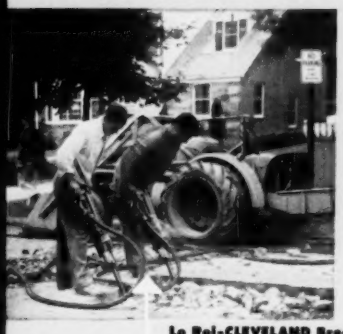

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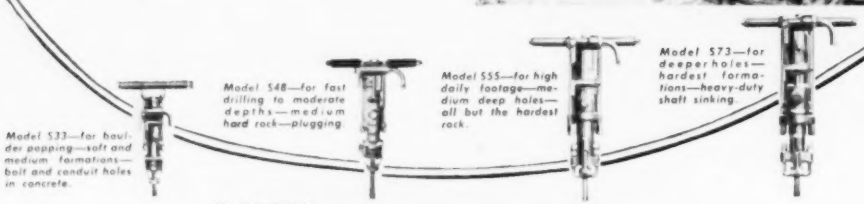

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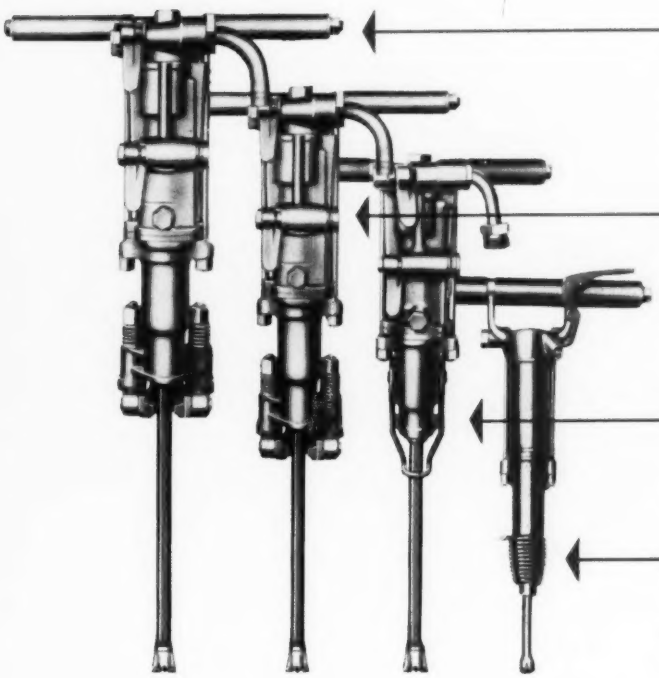

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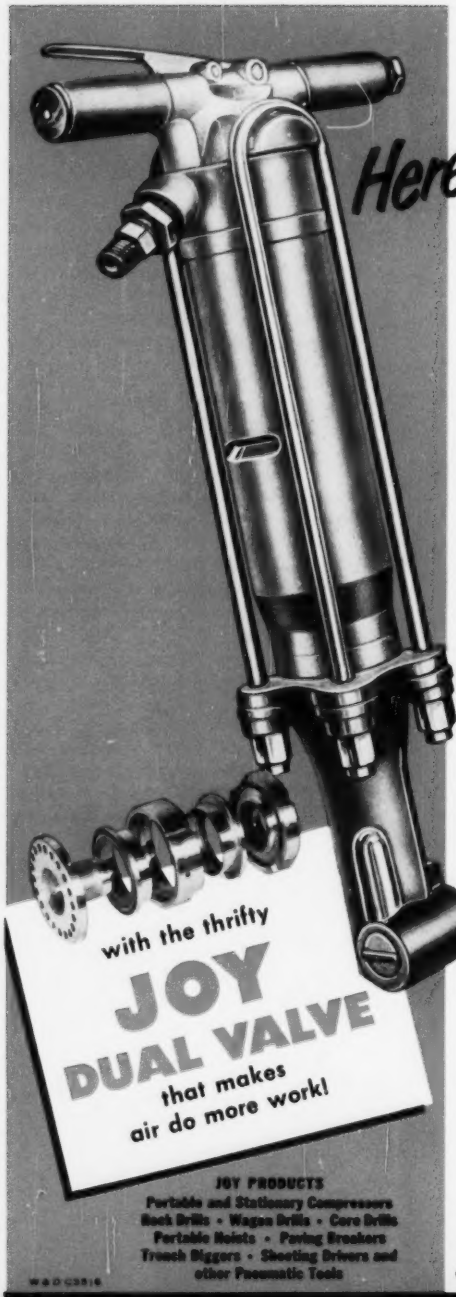


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